

DZero Status

DZero International Finance Committee

October 21, 2004



Current Demographics

Institutions:

84 Total

35 US, 49 non-US

Just added SMU, York, McGill

Collaborators

~ 670 Total

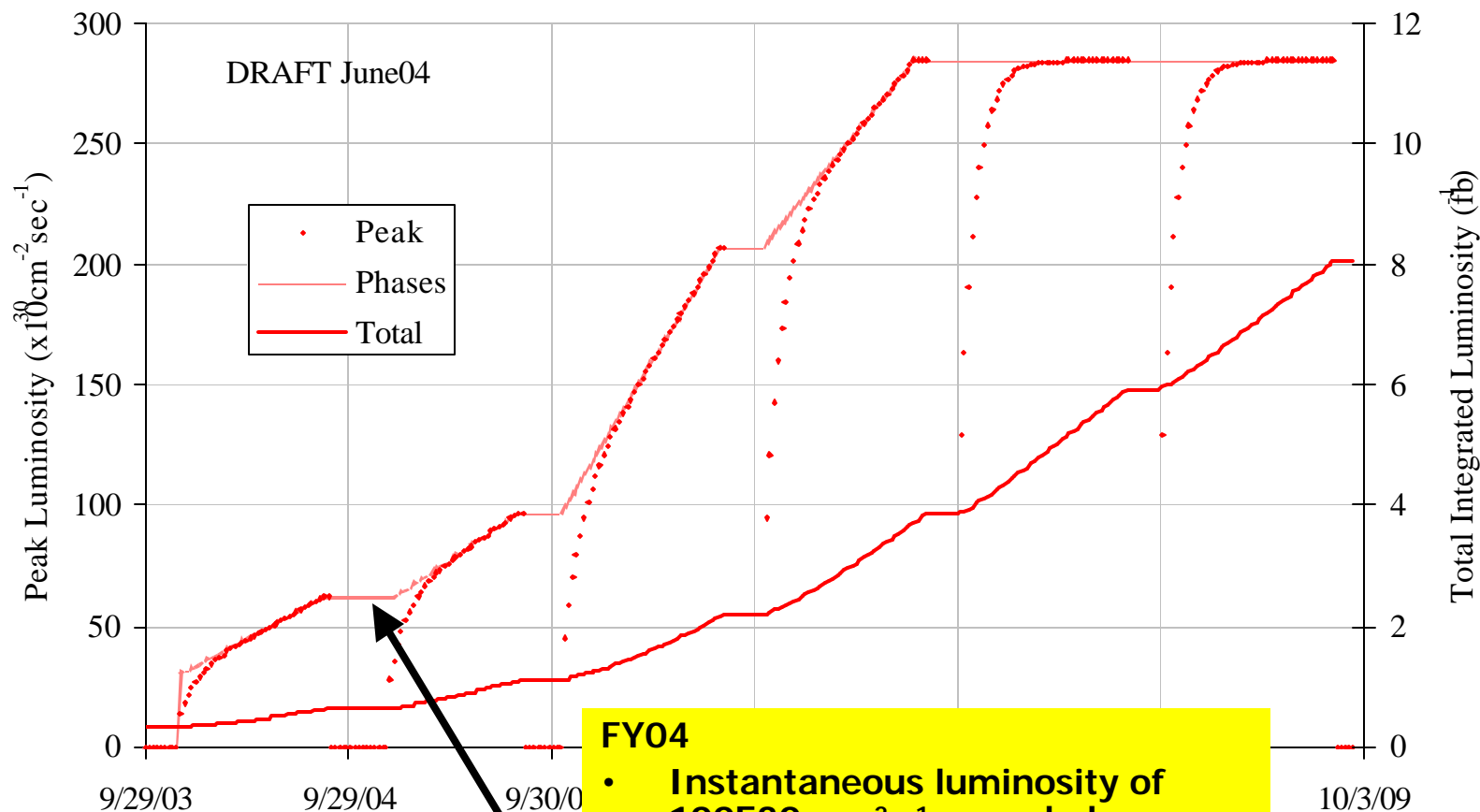
~ 50% from non-US institutions

~ 100 post-docs

~ 140 graduate students



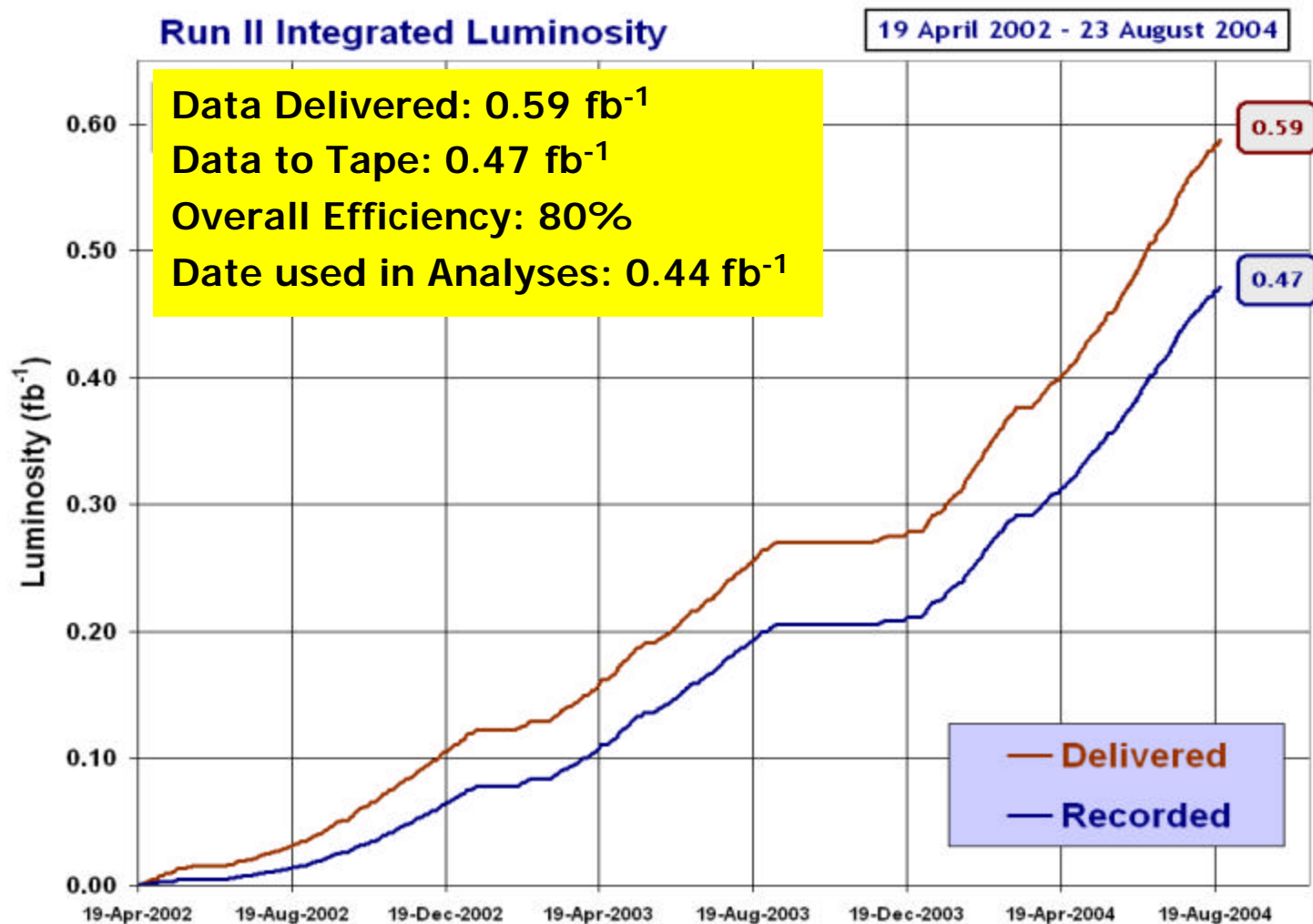
The Context: Run II Luminosity



FY04

- Instantaneous luminosity of $100 \times 10^{30} \text{ cm}^{-2} \text{ s}^{-1}$ exceeded expectations
- Integrated luminosity of 330 pb^{-1} at design
- Now in Aug – Nov 23 shutdown

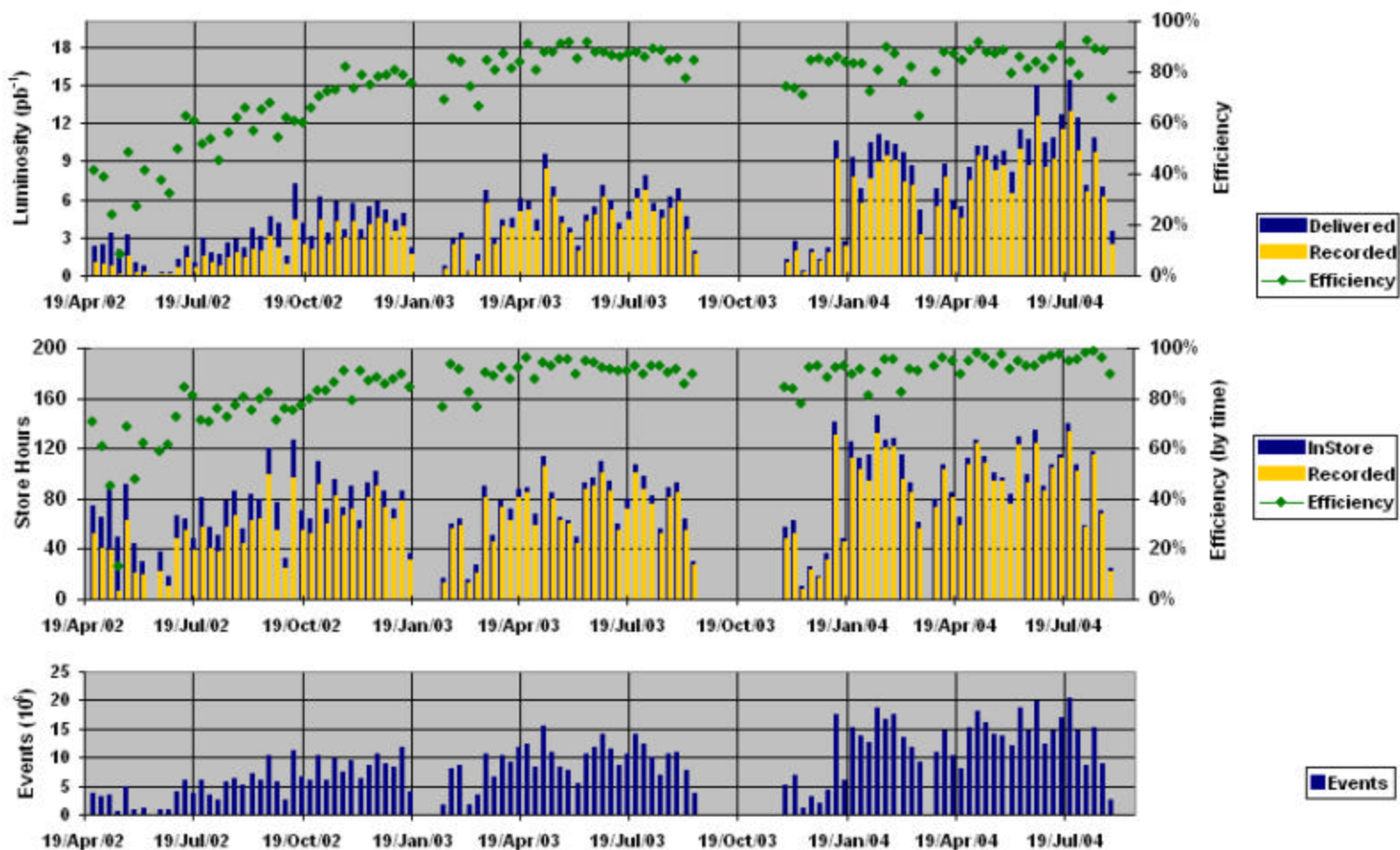
Run II Delivered and Logged Luminosity



**Our congratulations – and thanks – to the
Accelerator Division, Computing Division, and PPD**



Weekly Summary (19 April 2002 - 15 July 2004)



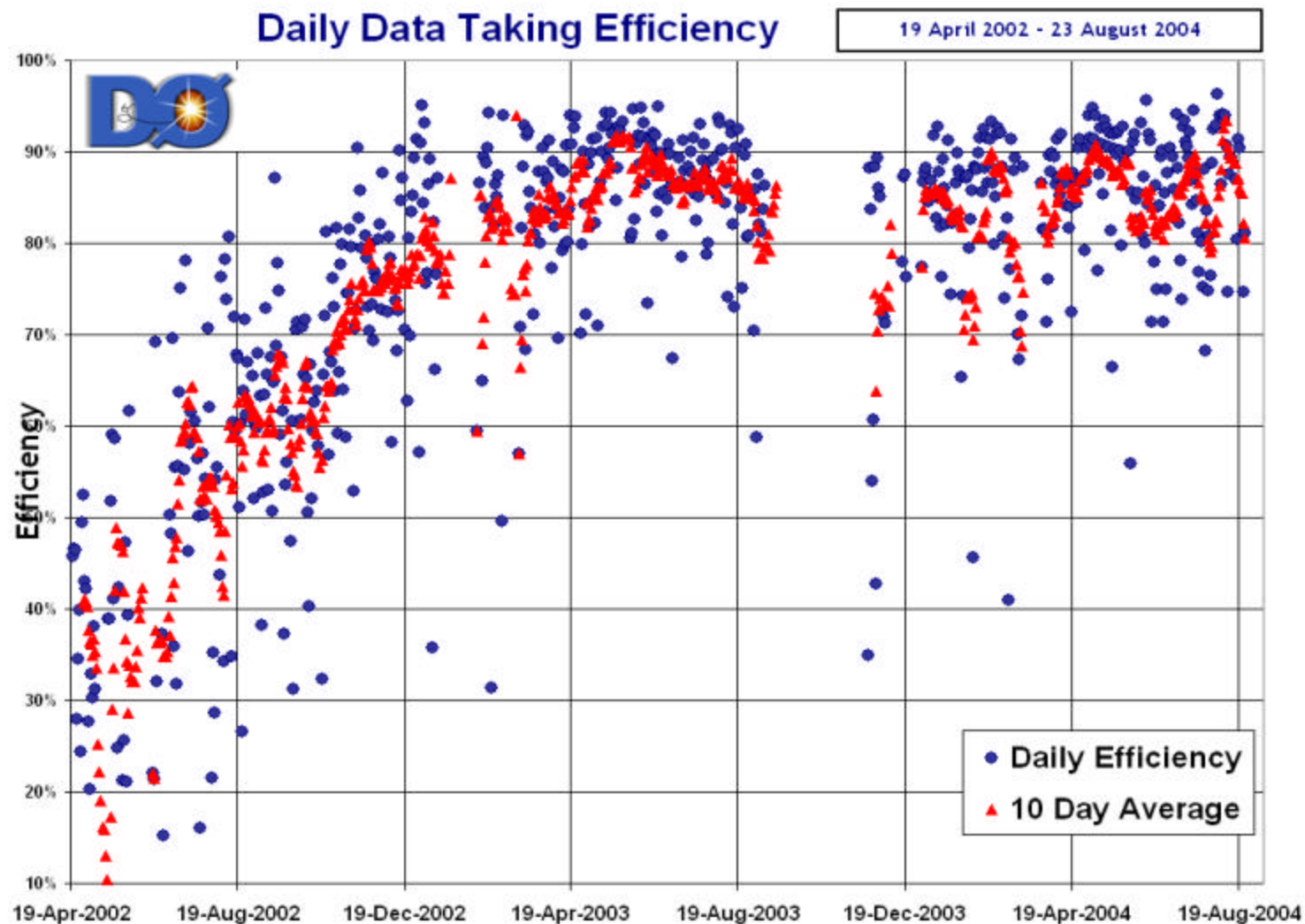
FY04

Data Delivered at DZero: 315 pb^{-1}

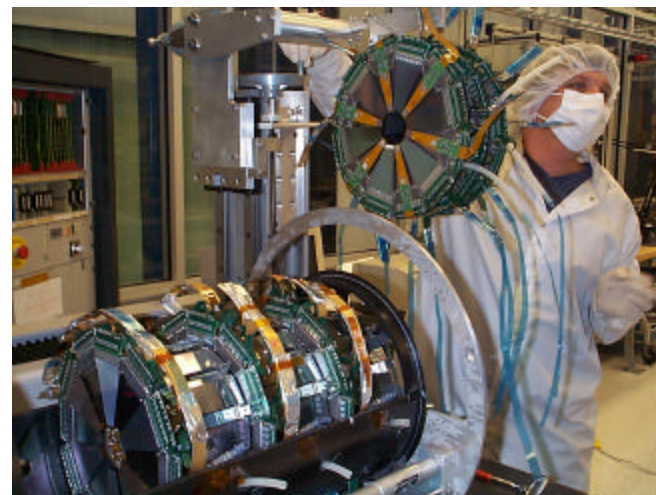
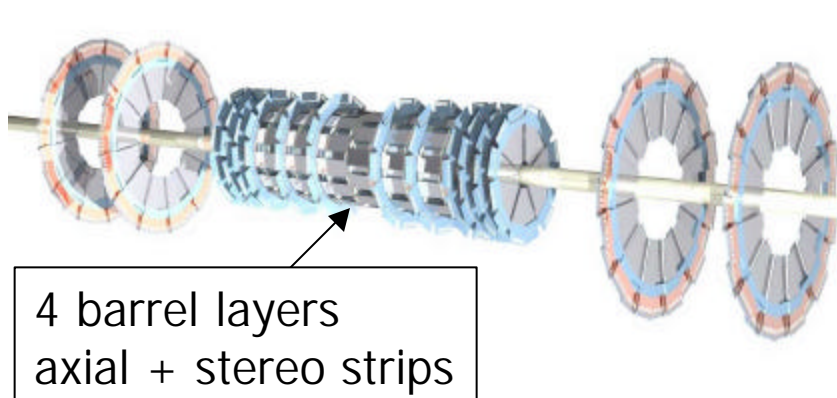
Data Recorded at DZero: 262 pb^{-1}

Efficiency: 83%

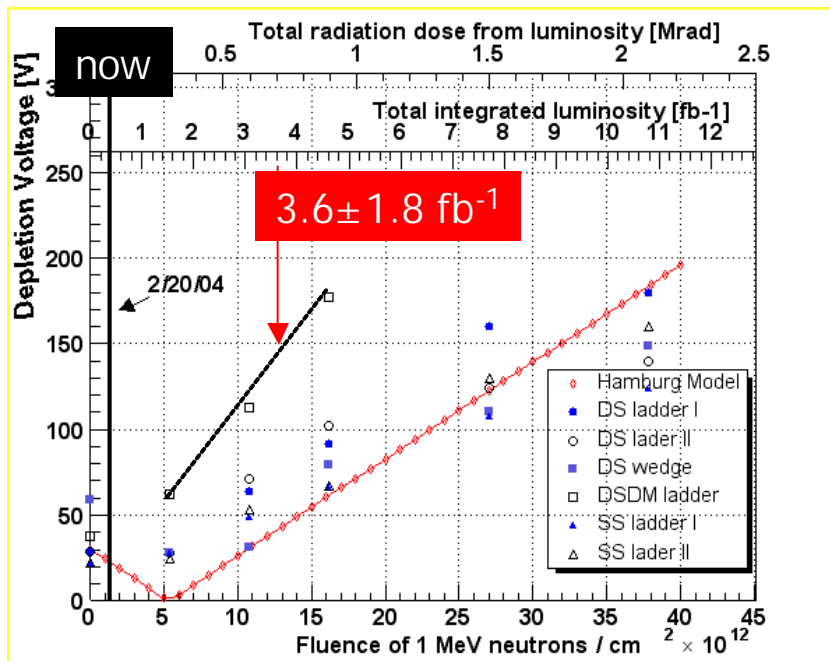




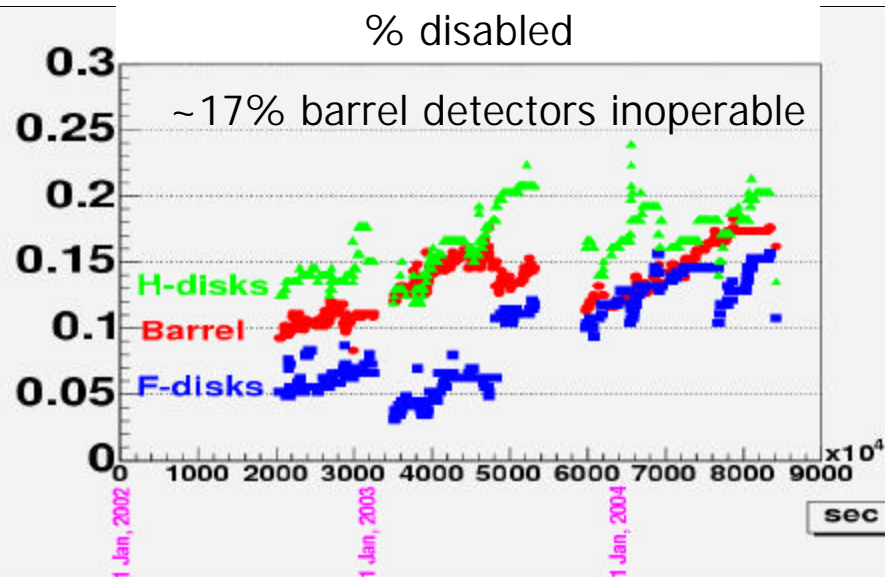
Silicon Microstrip Tracker



Detector working very well!
There is some concern over mortality

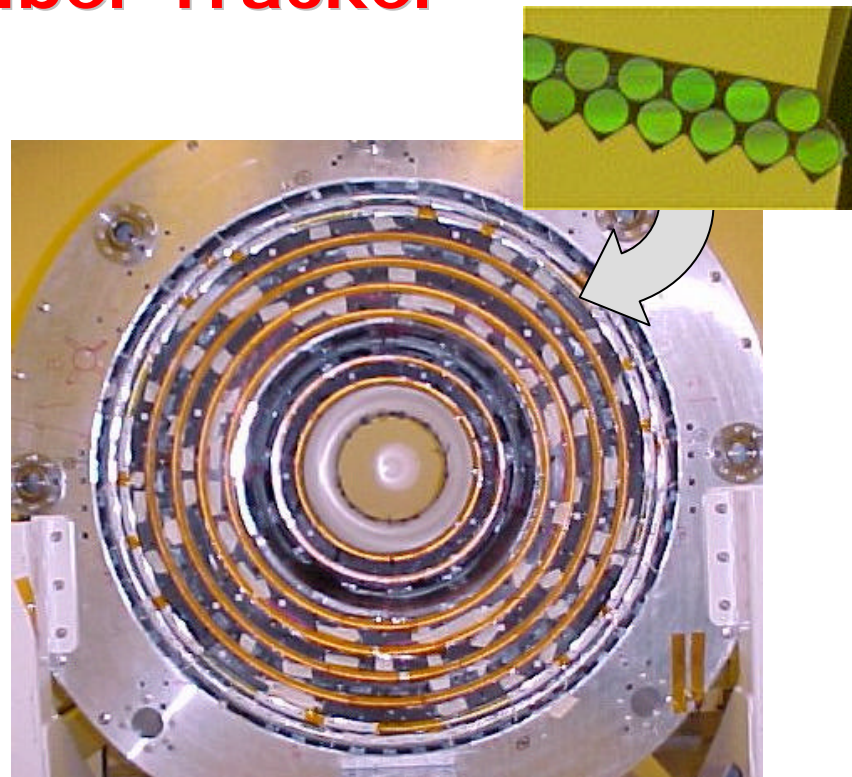


Radiation dose and damage



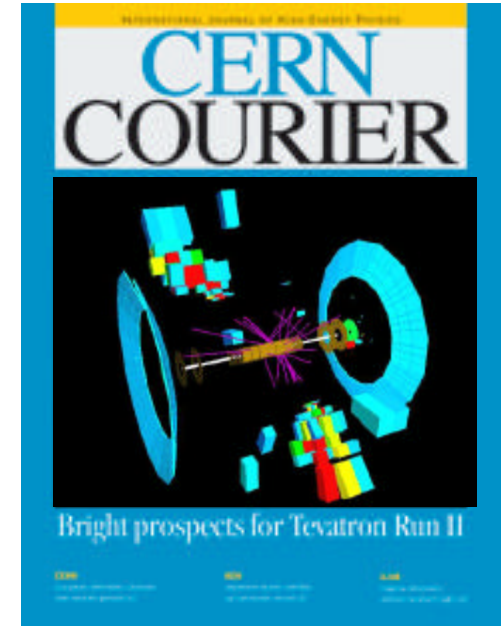
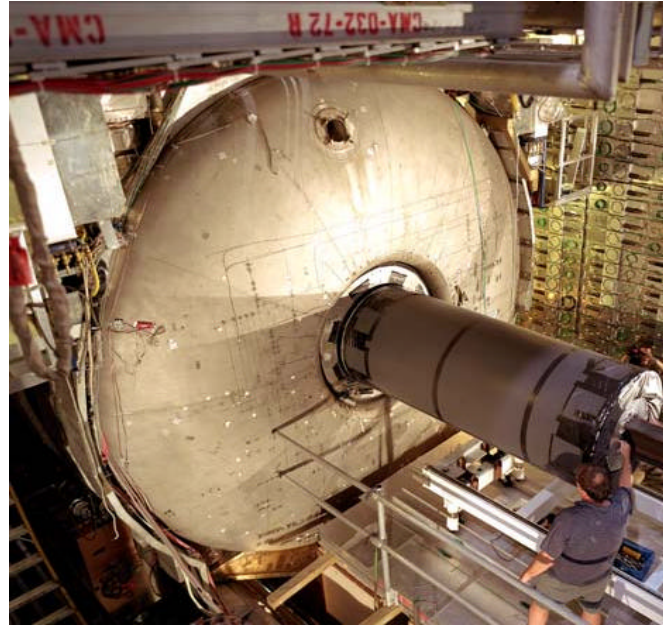
Scintillating Fiber Tracker

- Eight axial and eight stereo layers
- VLPC readout at 8K
- Performing well
 - good light yield
 - layer $\epsilon > 98\%$
- After November 2003 shutdown
 - ~ 1% of VLPC channels not functional
 - was 0.1% before November
 - a one-time event
 - water contamination in cryostat?
- This shutdown warmed up 1 (of 2) cryostats (major shutdown activity #1)
 - pumped out 0.5l H₂O
 - Upon cool down same loss rate
 - BUT different channels
- Will not seriously degrade performance but is a worry.



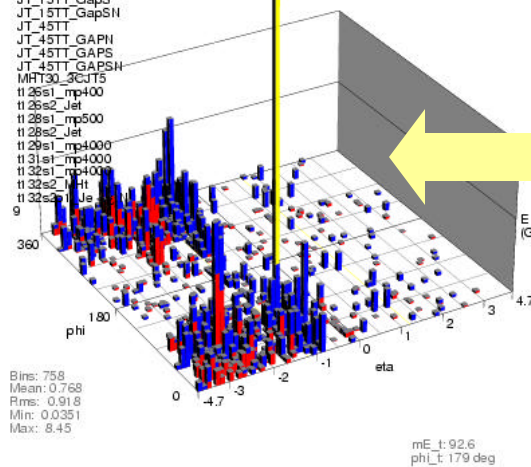
Calorimeter

Liquid argon calorimeter
with uranium absorber
50k channels, 99+%



Run 190005 Evt 25738964 Fri Mar 5 12:50:05 2004

Triggers:
JT_15TT_GapH
JT_15TT_GapS
JT_15TT_GapSH
JT_45TT
JT_45TT_GAPN
JT_45TT_GAPS
JT_45TT_GAPSH
MHT30_3Cut5
tt 28s1_mp400
tt 28s2_Jet
tt 28s1_mp500
tt 28s2_Jet
tt 29s1_mp4000
tt 31s1_mp4000
tt 32s1_mp4000
tt 32s2_MHT
tt 32s2_Jet



**Intermittent noise
problems**

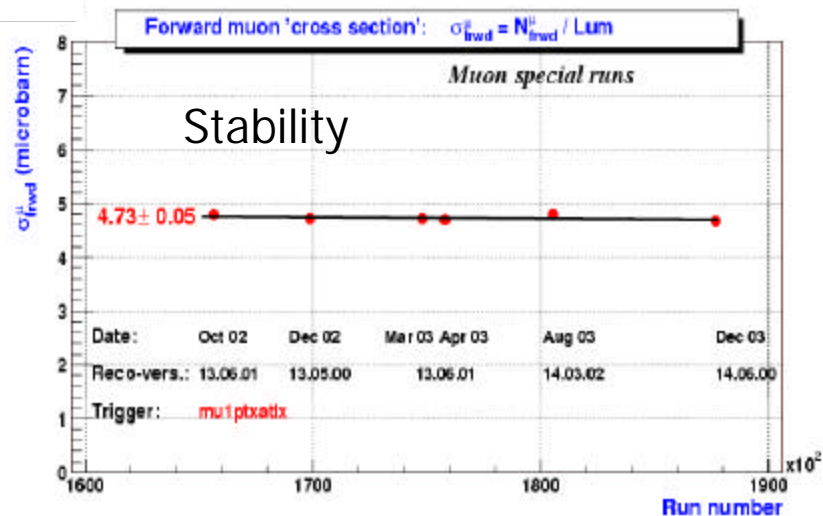
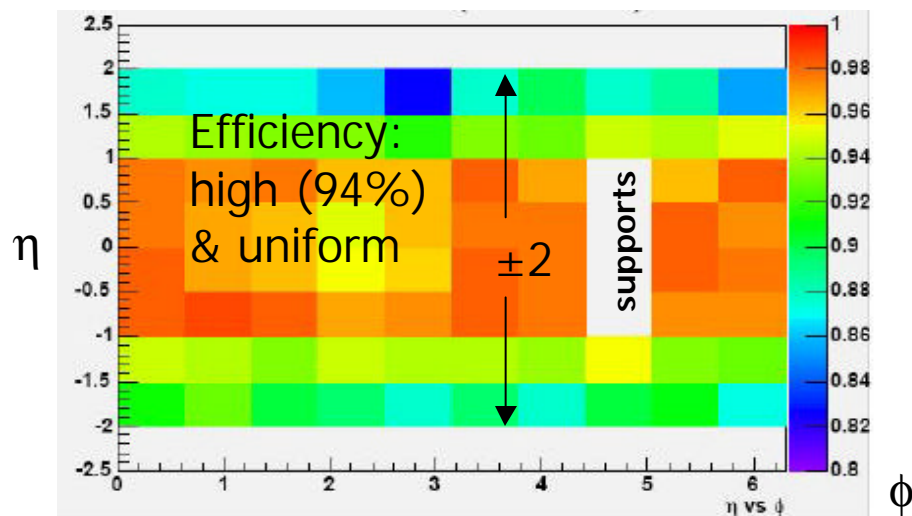
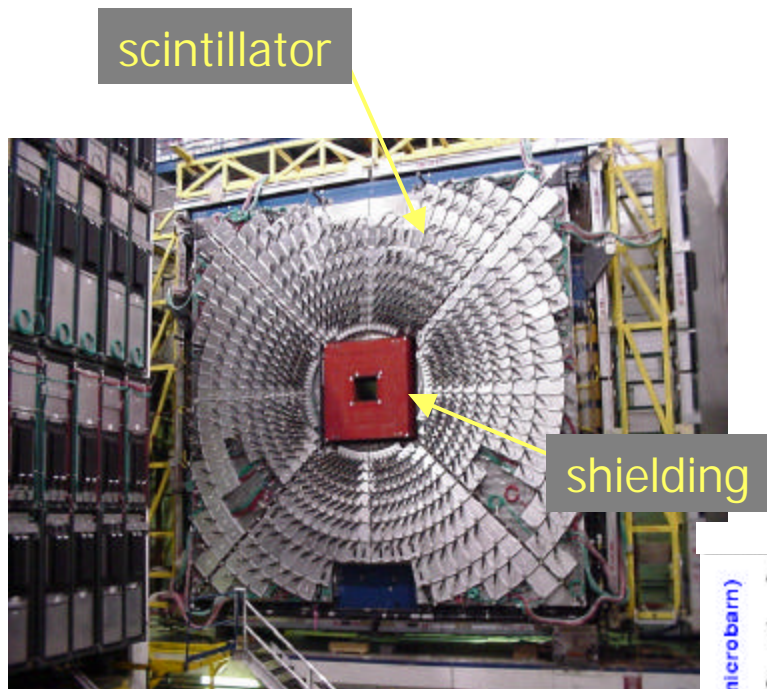
**During shutdown restored
platform isolation (major
activity #2)**

**Removed nearly 20 dead
shorts - welding noise
down four orders of mag.**



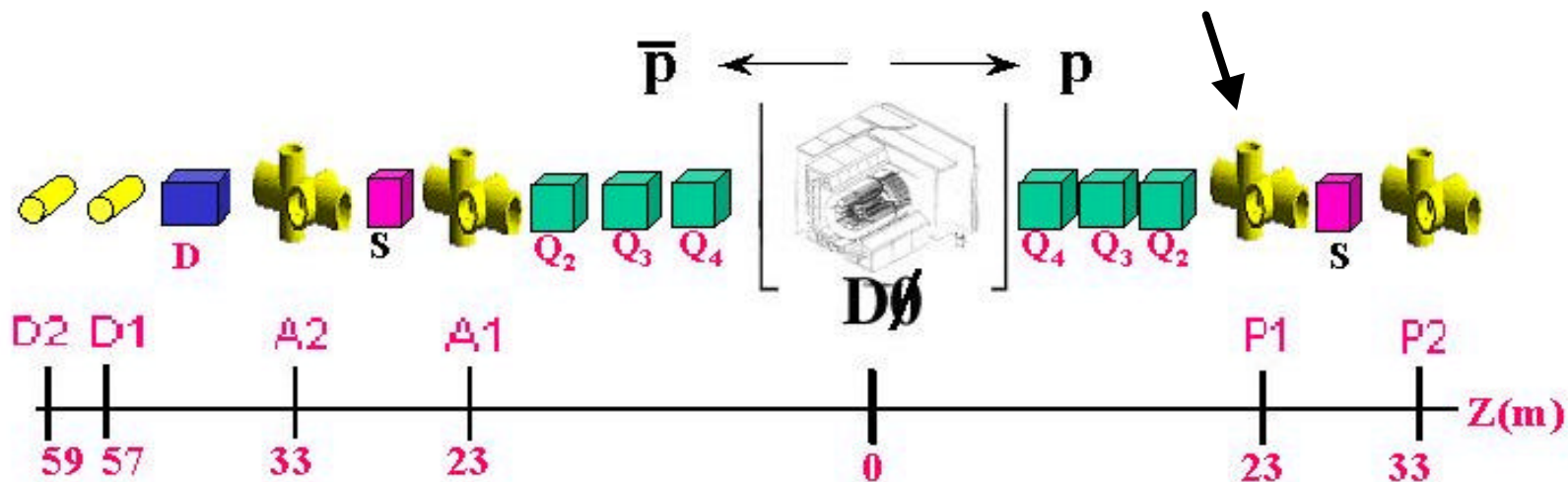
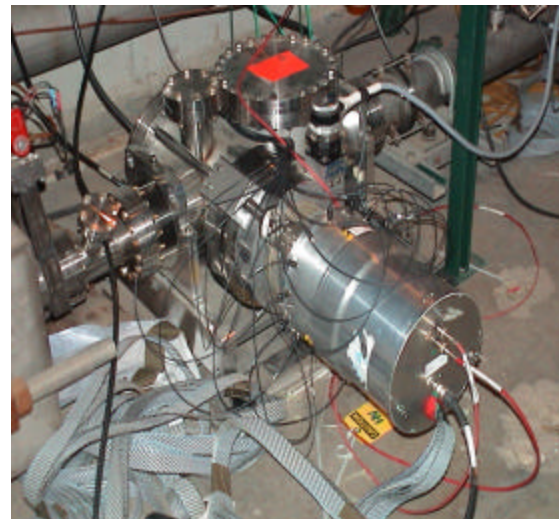
Muon System

- Three layers of scintillator planes for triggering, 99+% channels
- Three layers of drift tubes for muon track measurement, 99+% channels



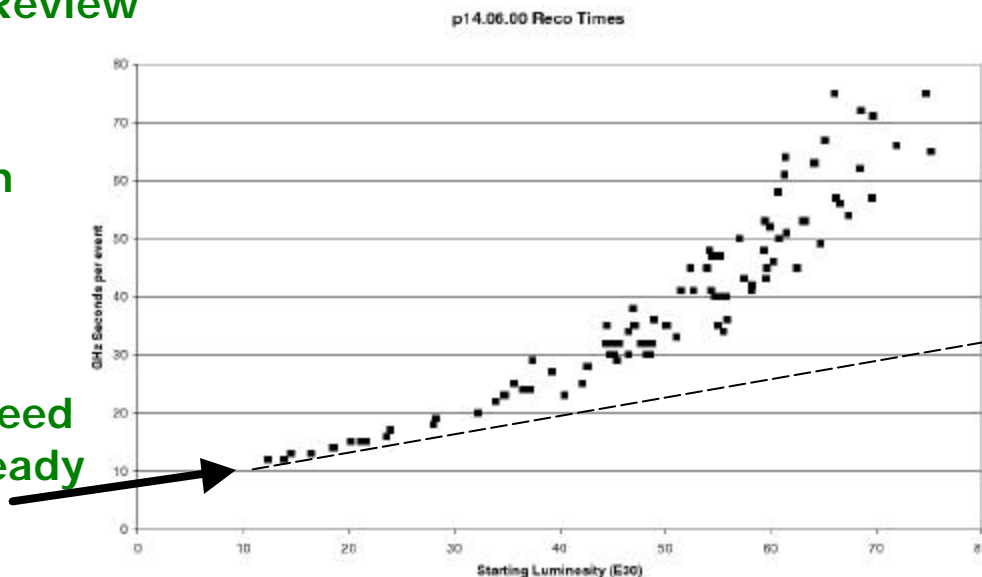
Forward Proton Detector

- Detector fully installed and operational
- Trigger commissioning underway
- Planning for full physics capability this winter



Processing Status & Plans

- Computing (See talk by A. Boehnlein)
 - Keeping up with reconstruction & simulation
 - >1 billion events processed!
 - ~1 million MC events/wk
 - Recent Computing (Shank) Review went extremely well
- Algorithms
 - Latest reconstruction version (P17) just released
 - Cal Calibration
 - Grid Friendly
 - Necessary to improve speed performance. ~30% already realized with CD help.
- Processing
 - All post shutdown data will be processed with P17
 - Reprocess entire 0.47 pb-1 data set remotely with P17 (See talk by G. Davies)



Recent Results

About 40 new results were approved for summer conferences, the complete list can be found from the "Recent Results" page:

<http://www-d0.fnal.gov/Run2Physics/WWW/results.htm>



- A few highlights:

- world's best B_s $\mu\mu$ limit;
- observation of B^{**} and B_c ;
- WW cross section;
- direct measurement of W width;
- Z? $t\bar{t}$;
- many SUSY and LED searches;
- $t\bar{t}$ cross section;
- first Run II result on m_t ;

Please feel free to visit the pages for details on all 60+ analyses underway



Submitted Run II Papers

- Search for Doubly-charged Higgs Boson Pair Production in the Decay to $m^+m^+m^-m^-$ in ppbar Collisions at $\sqrt{s}=1.96$ TeV
 - [hep-ex/0404015](#)
 - Primary Authors: Zdrazil, Soldner-Rembold, Kharchilava
- Observation and Properties of the X(3872) Decaying to J/ψ pp in ppbar Collisions at $\sqrt{s}=1.96$ TeV
 - [hep-ex/0405004](#)
 - Primary Authors: Abbott, Hall, van Kooten, Jain
- Search for Supersymmetry with Gauge Mediated Breaking in Diphoton Events at DØ
 - [hep-ex/0408146](#)
 - Primary authors: Gershtein, Kesisoglou
- Measurement of Dijet Azimuthal Decorrelations at Central Rapidities in ppbar Collisions at $\sqrt{s}=1.96$ TeV,
 - [hep-ex/0409040](#)
 - Primary Authors: Kupco, Begel, Demine, Royon, Wobisch, Zielinski
- Measurement of the B_s^0 Lifetime in the exclusive decay channel $B_s^0 \rightarrow J/\psi f$ at DØ
 - [hep-ex/0409043](#)
 - Primary Authors: Podesta-Lerma, Sanchez-Hernandez, Castilla-Valdez
- Search for the Flavor-Changing Neutral Current Decay $B_s^0 \rightarrow \mu\mu$ in ppbar Collisions at $\sqrt{s}=1.96$ TeV with the DØ Detector
 - [hep-ex/0410039](#)
 - Primary Authors: Ralf Bernhard, Frank Lehner

Accepted!

Accepted!

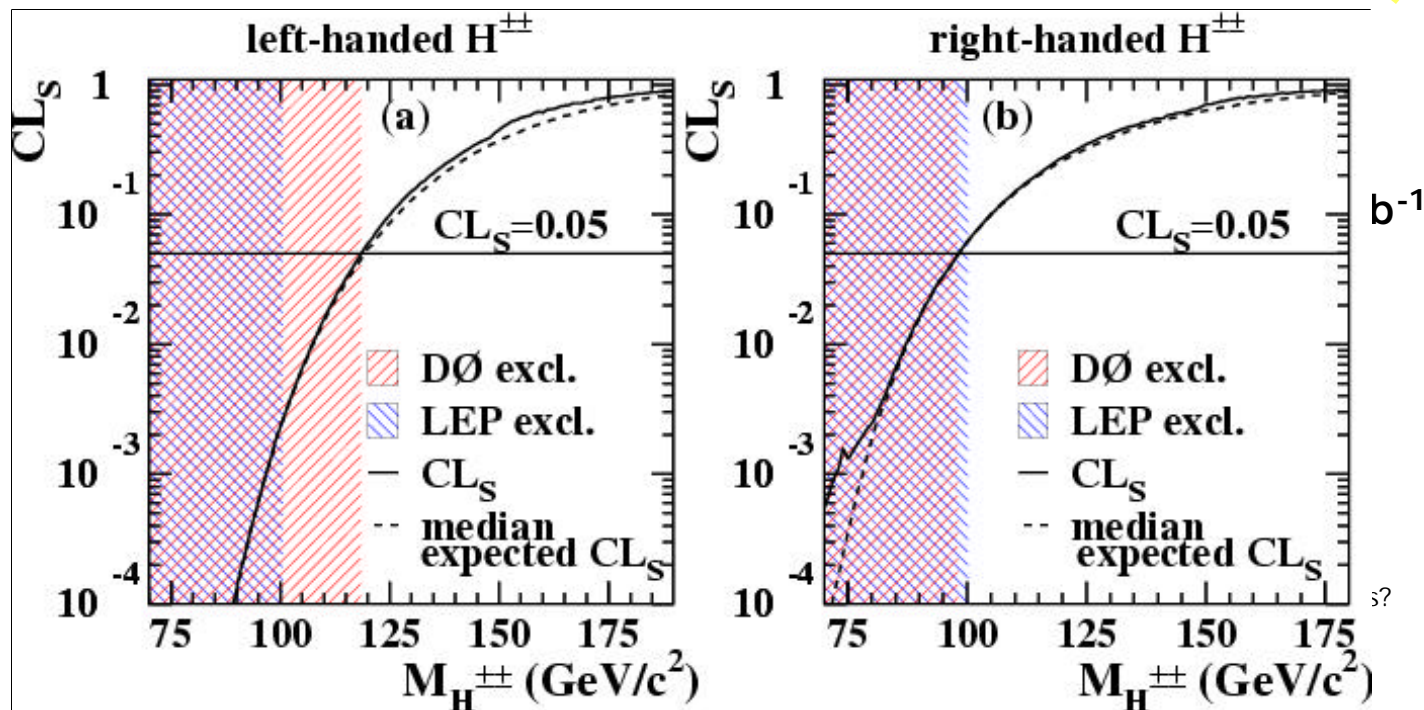


Non-standard Higgs searches

- With our current dataset, we don't expect to see standard model Higgs signal
 - looking for nonstandard variants
 - developing our tools, our understanding, and ability to model backgrounds (e.g. $W/Z + b\bar{b}$)

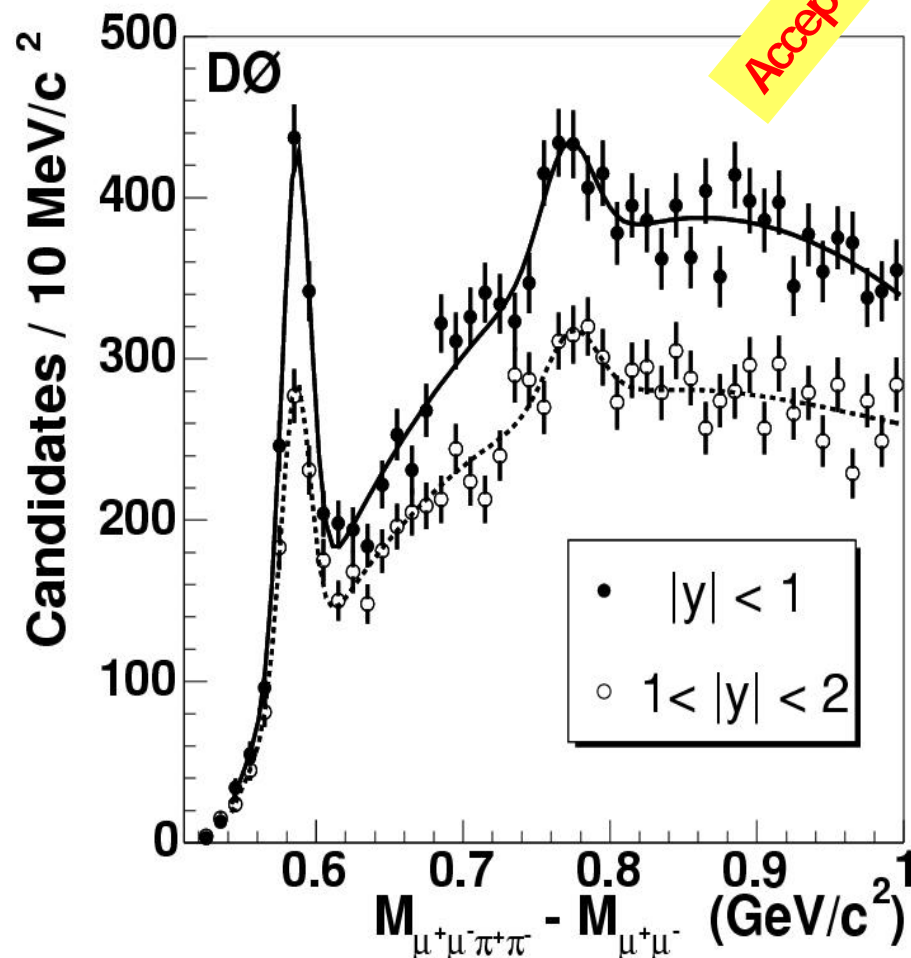
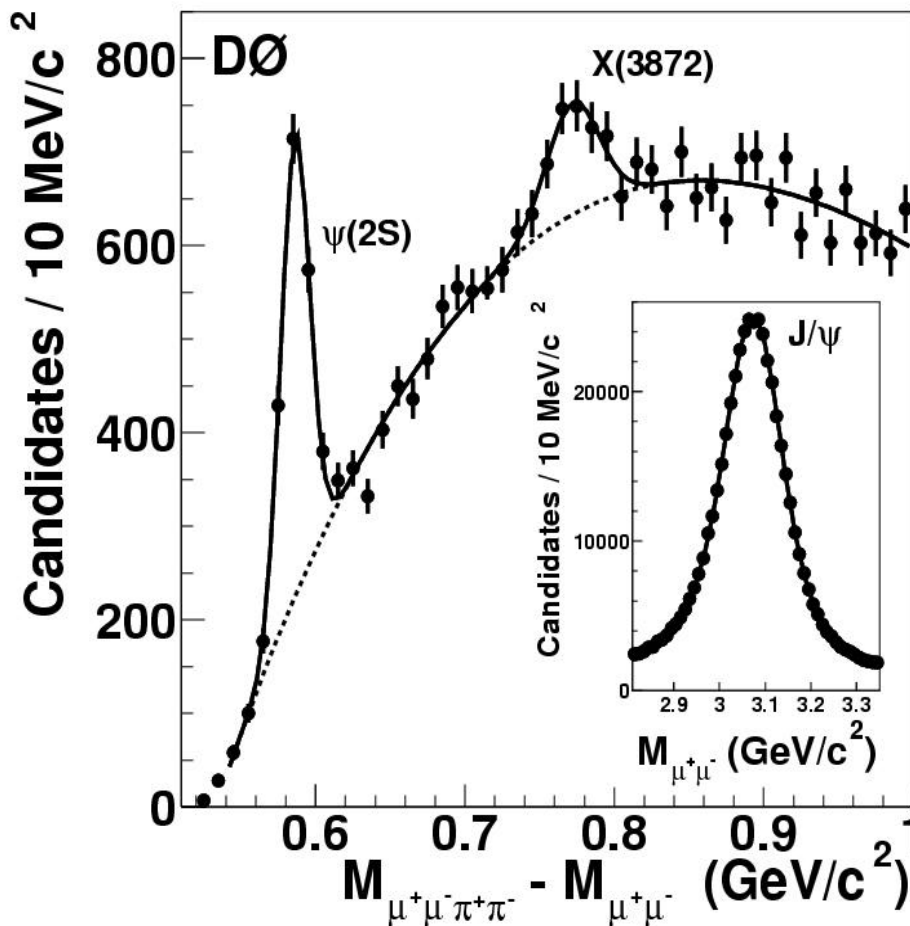
H⁺⁺ search

Accepted!



Heavy flavor and B Physics (exploiting our muon coverage)

Accepted!

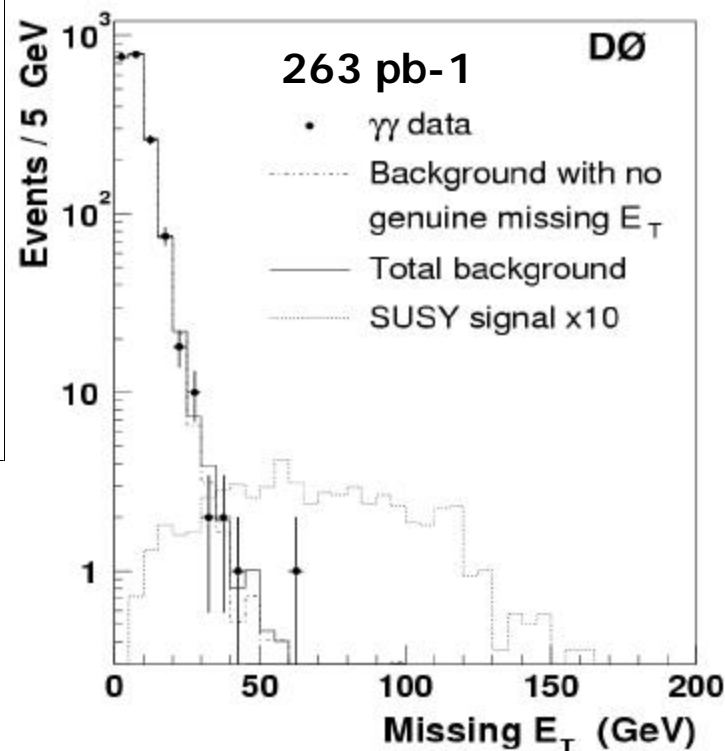
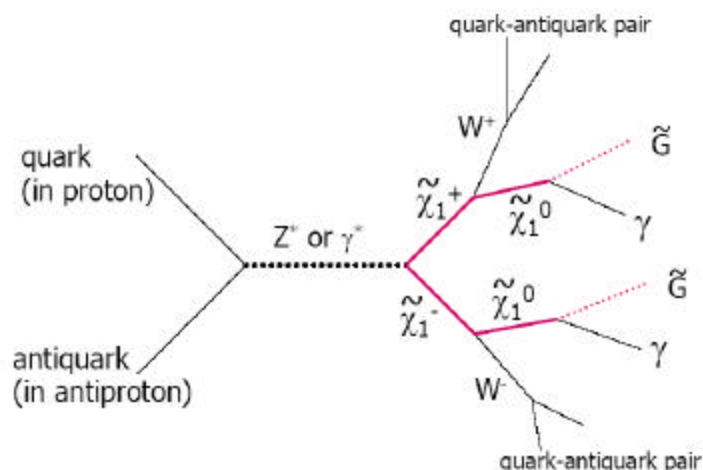


X(3872) ® J/ψ p⁺p⁻

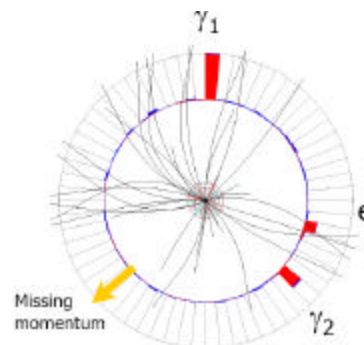
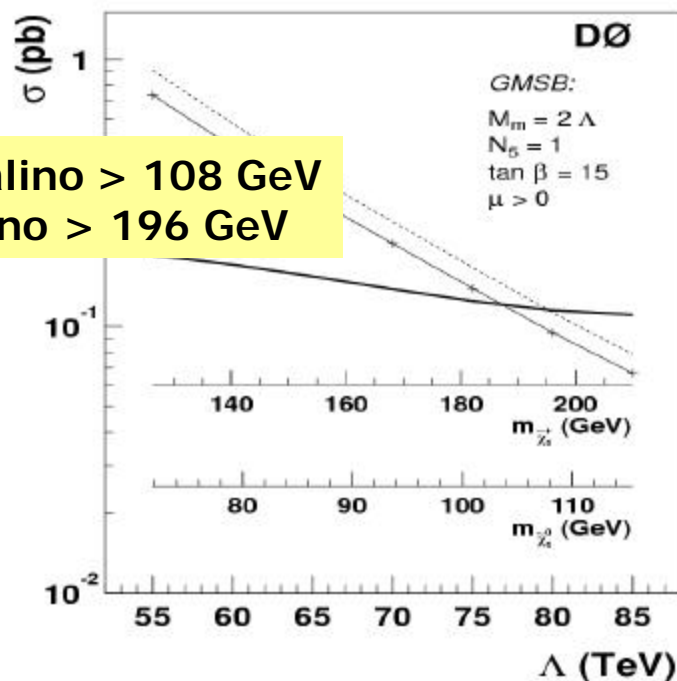


Searching for GMB SUSY with Diphotons

Submitted!



Neutralino > 108 GeV
Chargino > 196 GeV

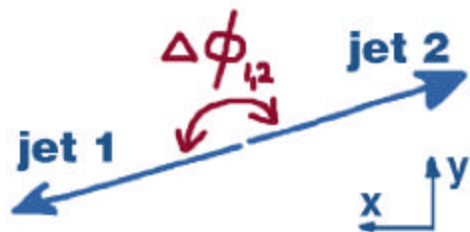


A view of the candidate event projected along the direction of the beams

Dijet angular distributions

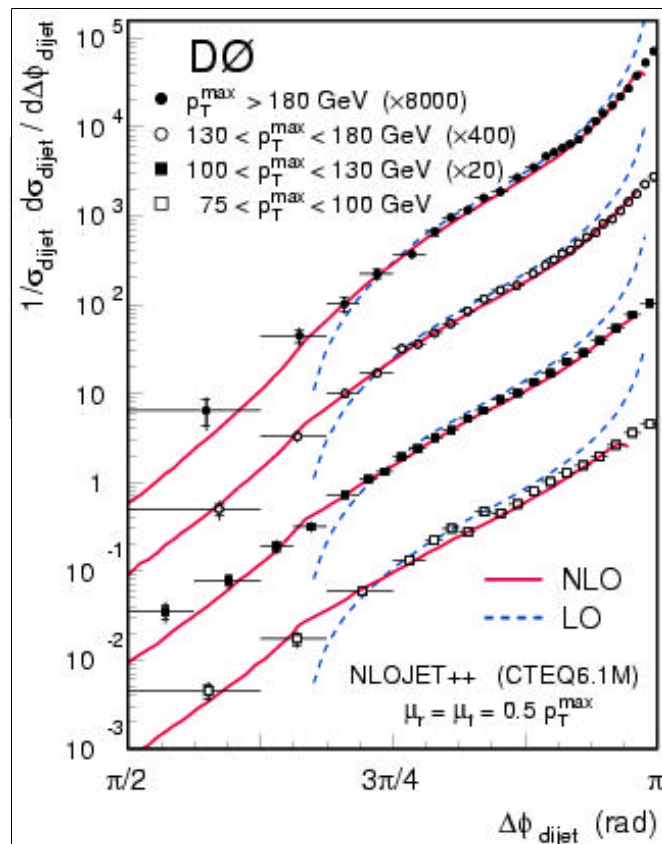
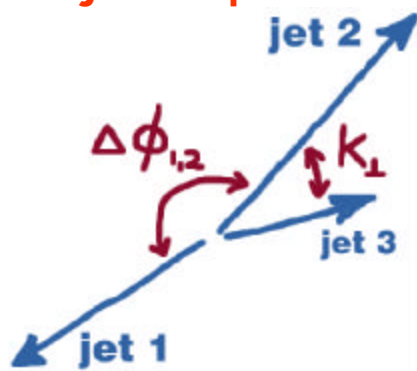
Compare with LO QCD and with parton shower Monte Carlo generators

Leading Order pQCD



Jets are back-to-back

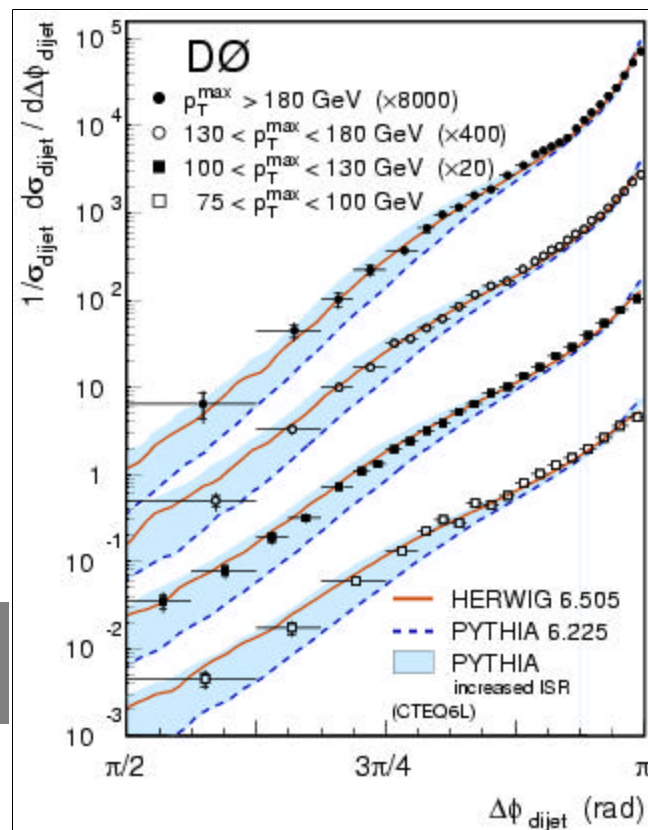
3 jets in pQCD



PYTHIA &
HERWIG

LO QCD
not a good
description

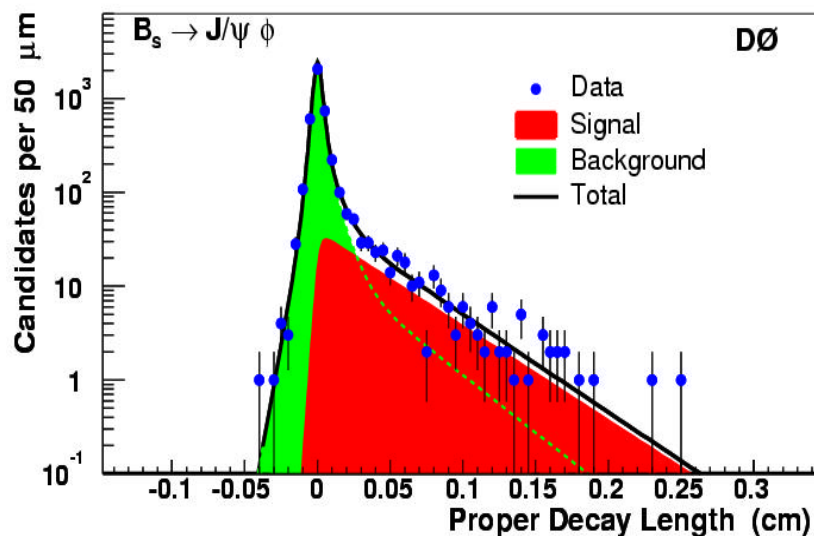
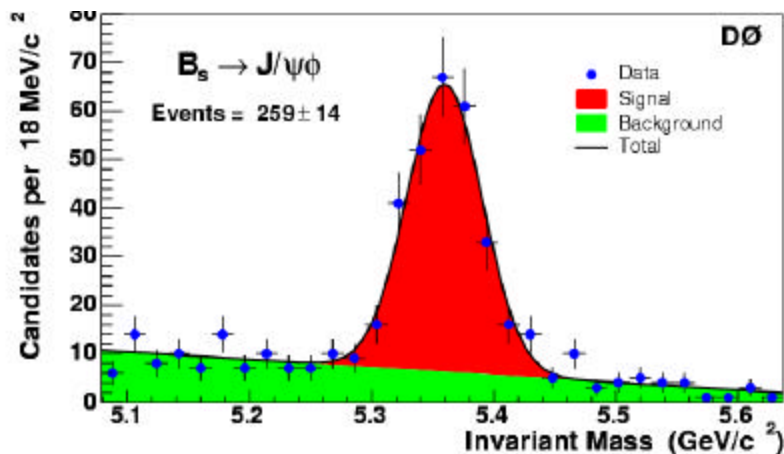
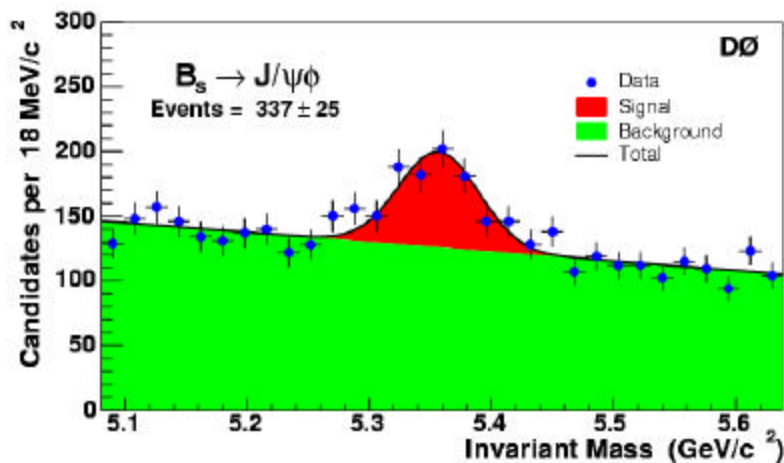
Submitted!



B_s^0 Lifetime

Submitted!

- Meson lifetimes test quark models
- Single most precise measurement of $B_s \rightarrow J/\psi(m^+m^-) f(K^+K^-)$ lifetime

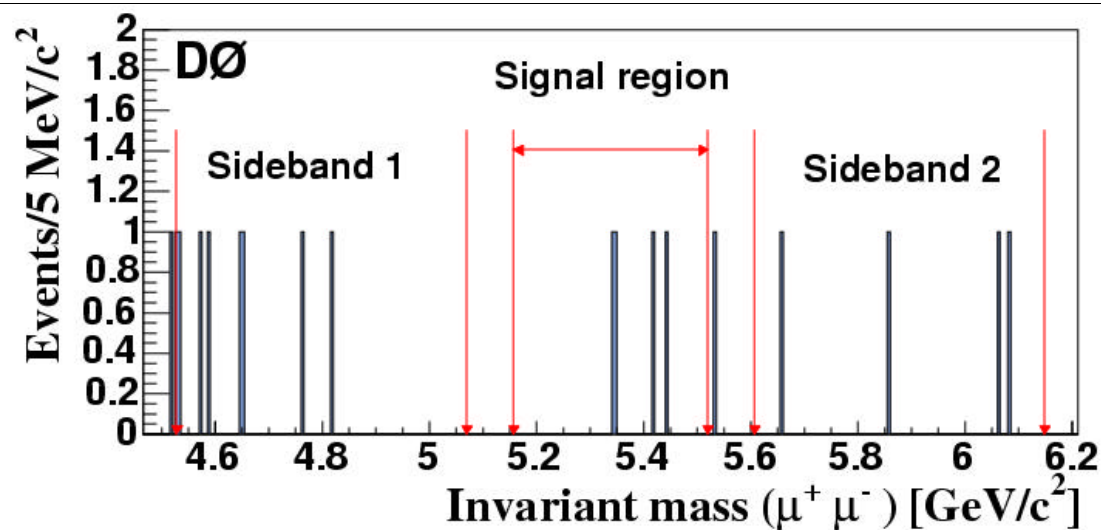
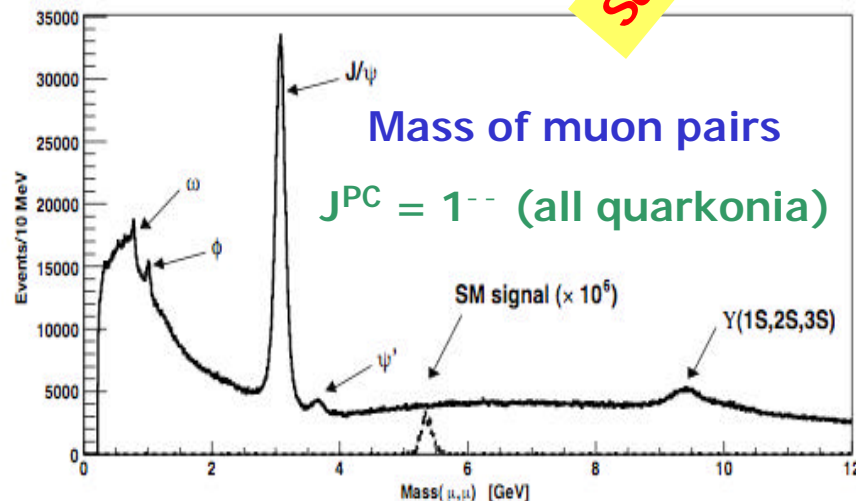


220pb⁻¹, 337 candidates
 $t = 1.444 (+0.098 - 0.090$
 stat) (0.020 sys)

Indirect searches for new particles

Submitted!

- Measure the rate of the rare decay $B_s \rightarrow m^+ m^-$
- In the Standard Model, cancellations lead to a very small branching ratio
 - SM BR = 3.7×10^{-9}
- New particles (e.g. SUSY) contribute additional Feynman diagrams, increase BR
 - up to 10^{-6}



Final result (240pb⁻¹ of data)

- Observed 4 events
- Expect 3.7 ± 1.1 bkg.
- BR ($B_s \rightarrow m^+ m^-$) < 5.0×10^{-7} (95% CL)
- World's best limit!



Run II Papers in Final Collaboration Review

- Measurement of the L_b lifetime in the decay $L_b \rightarrow J/\psi L$ with the DØ detector
 - Primary authors: Cruz-Burelo, Castilla-Valdez, Sanchez-Hernandez
- A search for Wbb and WH Production in ppbar Collisions at $\sqrt{s}=1.96$ TeV
 - Primary Authors: Beauceron, Bernardi
- Measurement of the Ratio of B+ and B0 Lifetimes with the DØ Detector
 - Primary Authors: Borissov, Burdin, Nomerotski
- A Measurement of the Ratio of Inclusive Cross Sections Zb/Zj at $\sqrt{s}=1.96$ TeV
 - Primary Authors: Kazu Hanagaki, Yildirim Mutaf, Suyong Choi, Qizhong Li
- Measurement of the WW production cross section in ppbar collisions at $\sqrt{s}=1.96$ TeV
 - Primary Authors: Johannes Elmsheuser, Marc Hohlfield
- A search for anomalous heavy-flavor quark production in association with W bosons
 - Primary Author: Wade Fisher

440 pb⁻¹
Submitted!

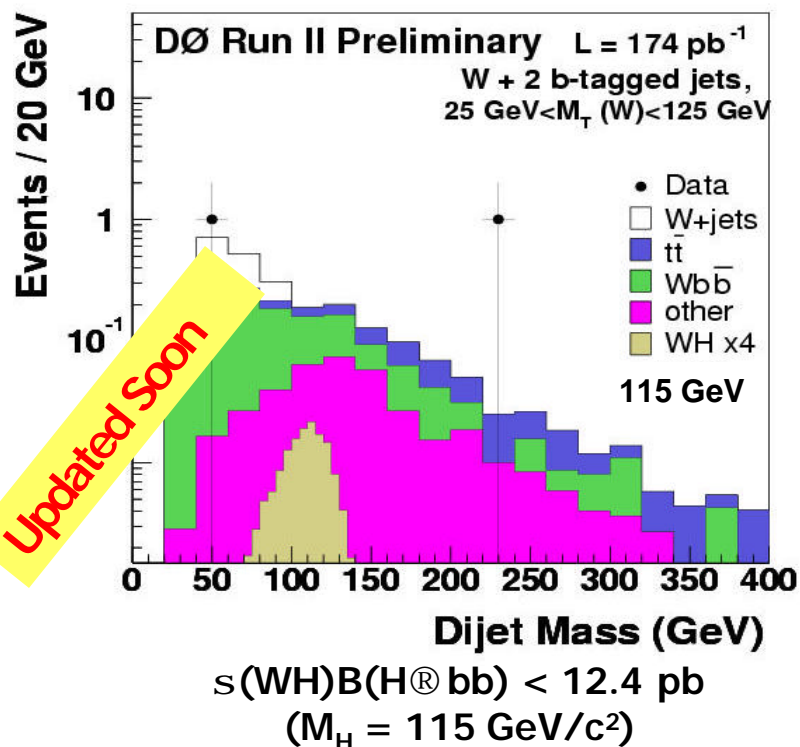
Now a few more results...



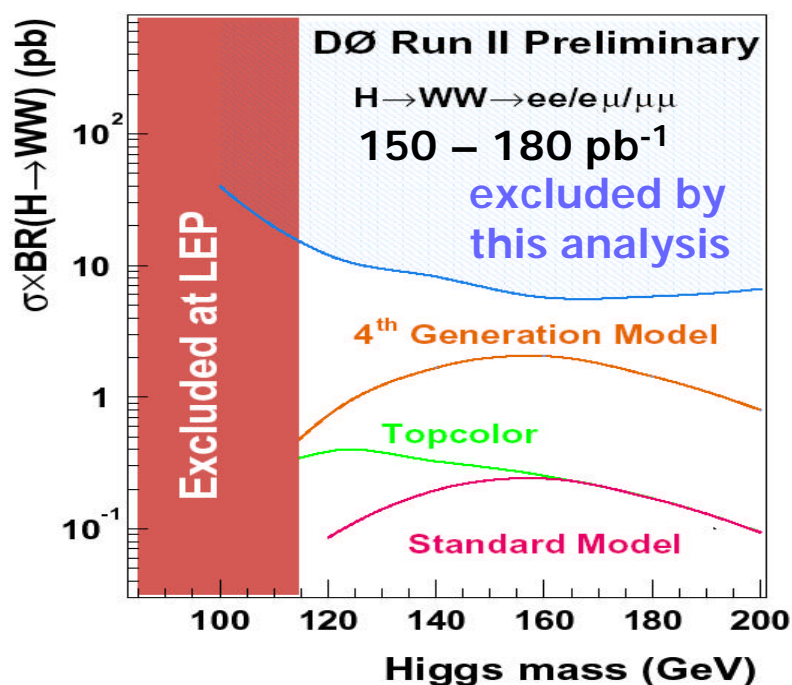
Standard Higgs Searches

The latest Tevatron luminosity plan makes it hard to cover the whole SM Higgs mass range, but we will do what we can — and the lowest masses (115 GeV!) are the most interesting

WH \otimes Wbb search

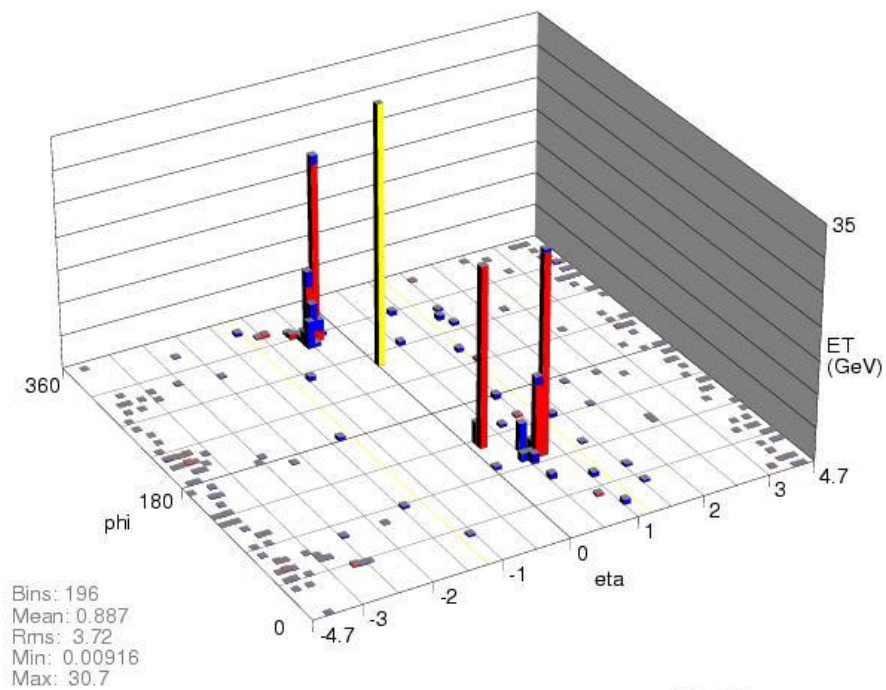


H \otimes WW search



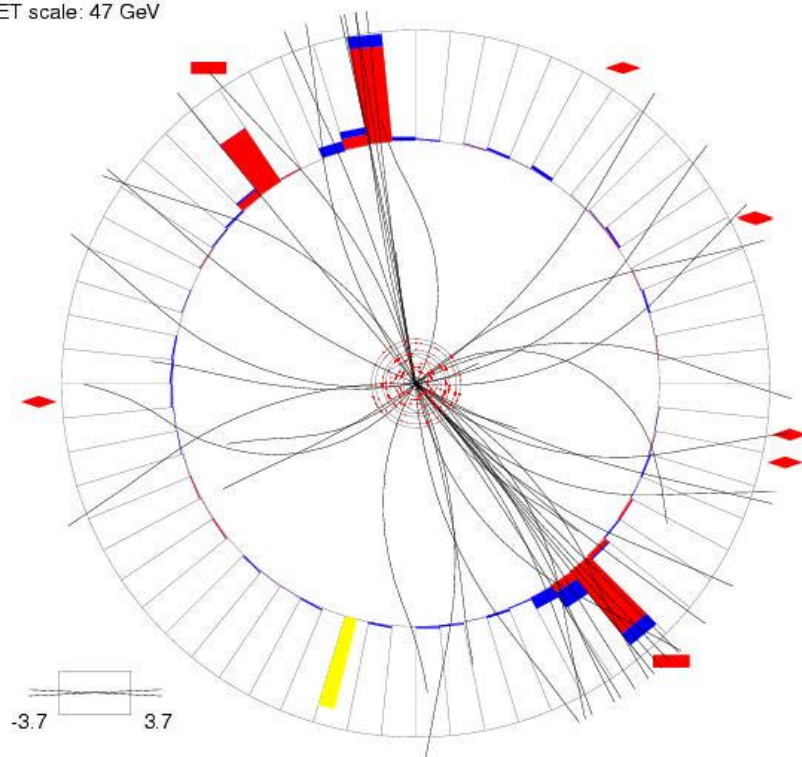
A High Mass Wbb Candidate

Run 172577 Event 3625634 Fri Mar 5 20:31:28 2004



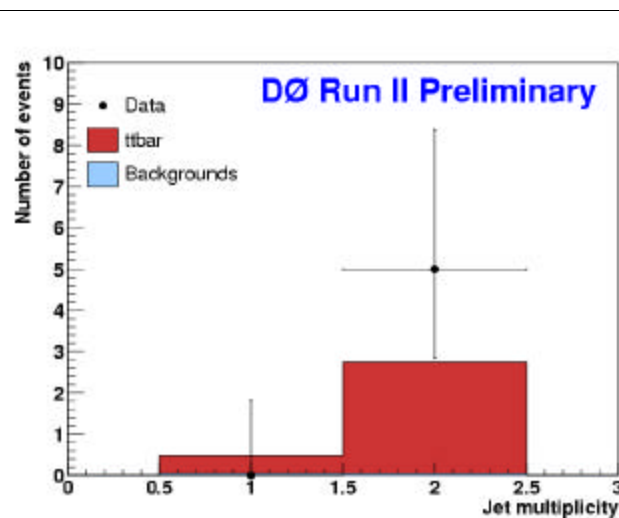
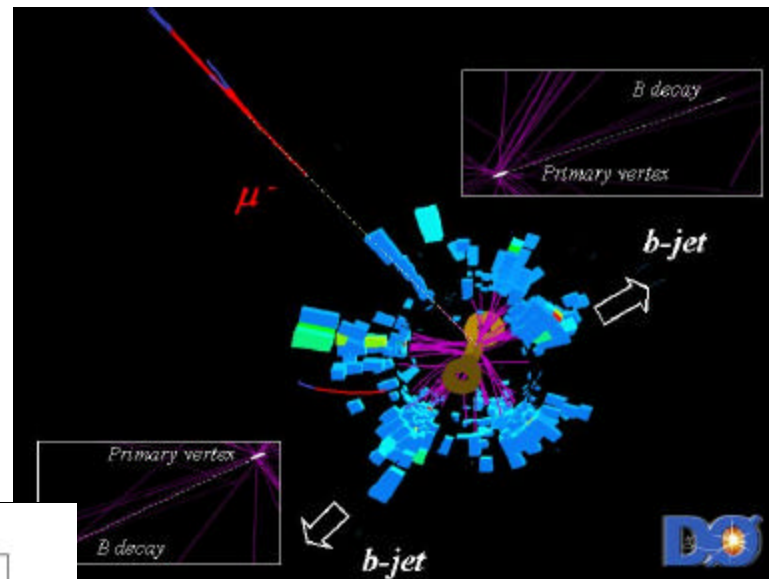
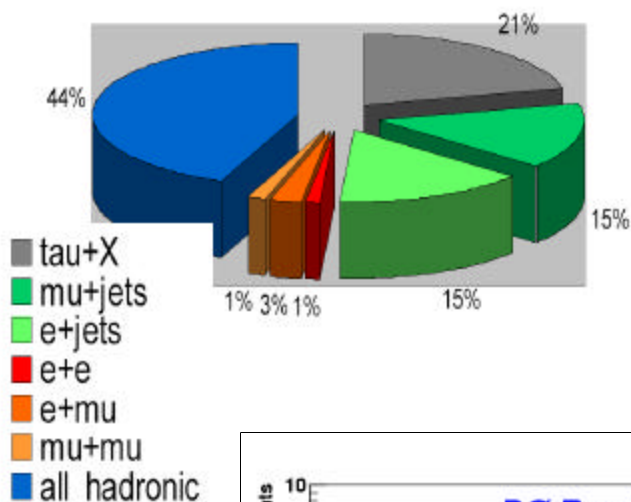
mE_t: 39.4
 phi_t: 255 deg

ET scale: 47 GeV



The Top Quark

The Tevatron Collider is the world's only source of top quarks
 Top couples strongly to the Higgs field: offers a window on
 fermion mass generation

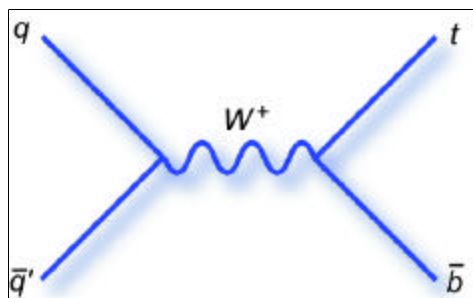


Example:
 em with two b-tags
 158 pb^{-1}
 $S/N > 70!$

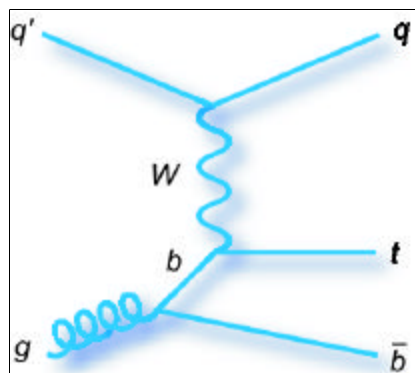
Top and Single Top Cross Sections

- Single Top SM $\sigma = 3 \text{ pb}$
- 170 pb^{-1}
- @ 95% CL

– s channel 19pb



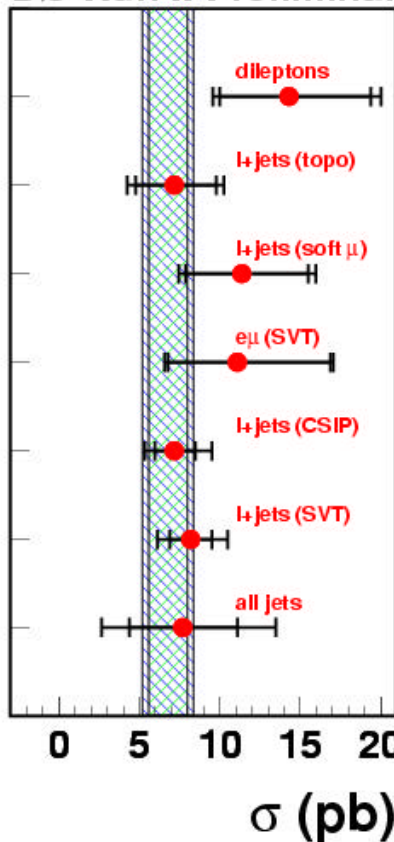
– t channel 25pb



- Combined 23 pb
- At Run I sensitivities

- Top-antitop SM $\sigma = 7 \text{ pb}$

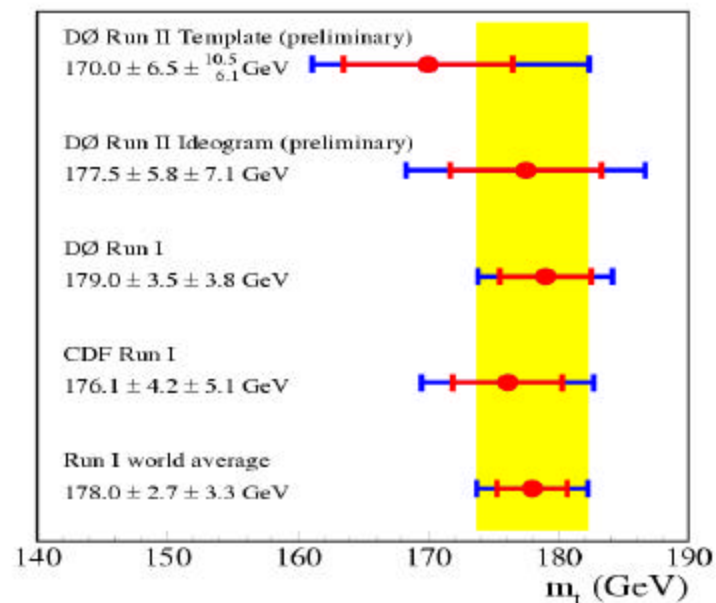
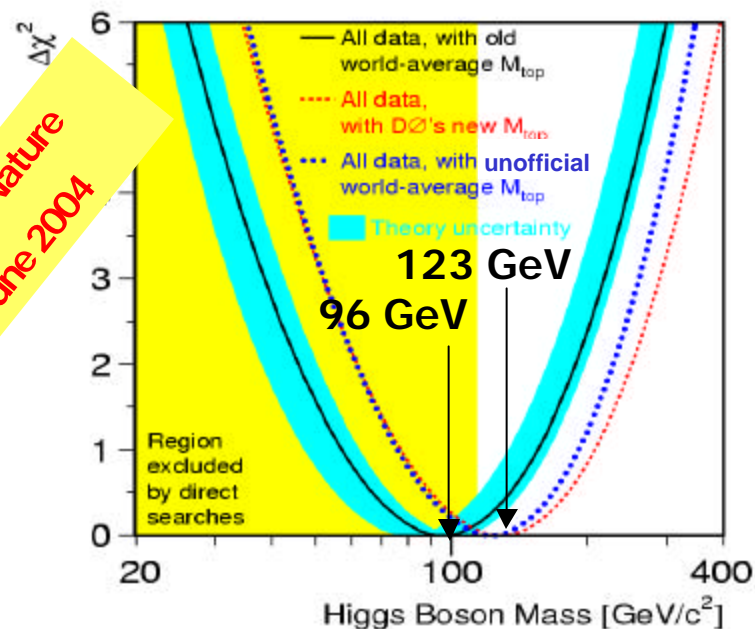
DØ Run II Preliminary



New Run I and Run II Top mass

$m_{\text{top}} = 179.0 \pm 5.1 \text{ GeV}$ (DØ combined)

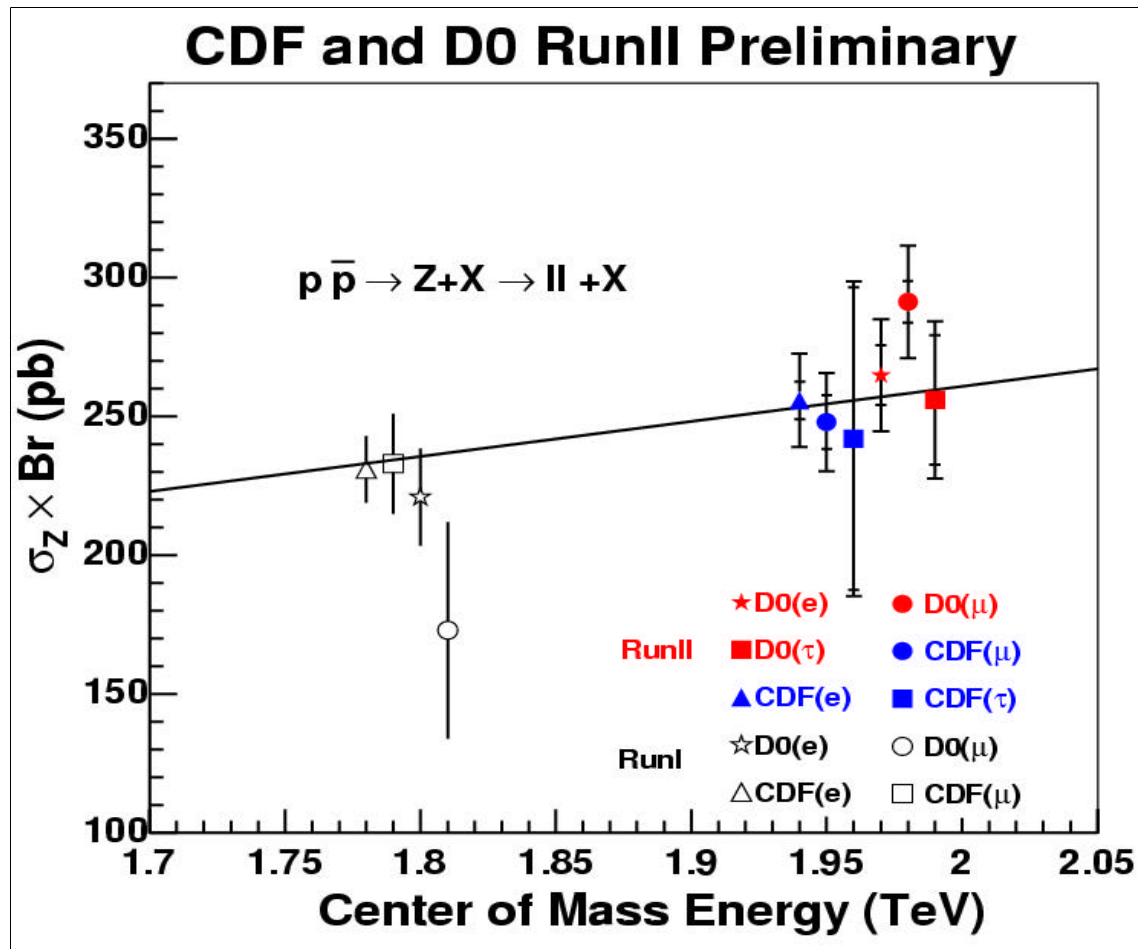
$m_{\text{top}} = 178.0 \pm 4.3 \text{ GeV}$ (official average)



First DZero Run II lepton + jets mass
160 pb⁻¹

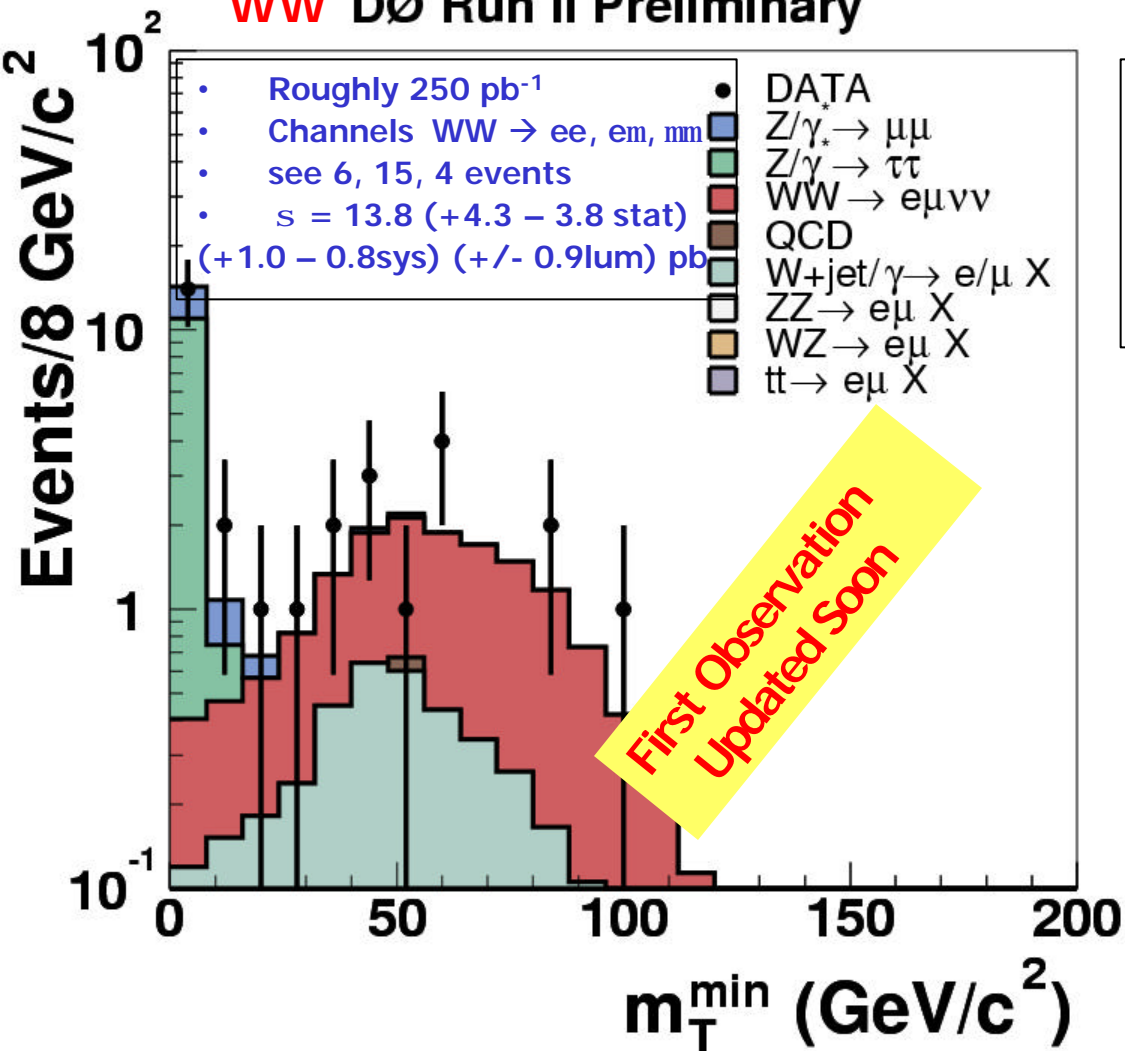
Boson Production

Now includes all three decay channels ee , $\mu\mu$, $\tau\tau$.



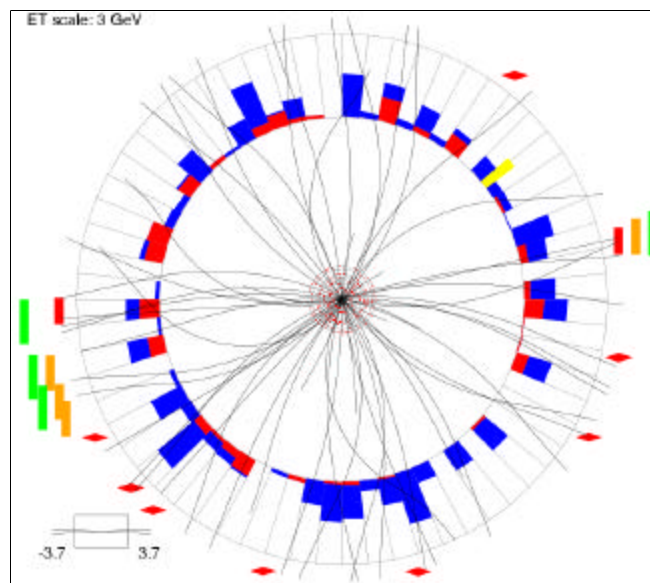
Diboson Production (a test of gauge couplings)

WW DØ Run II Preliminary



WZ DØ Run II Preliminary

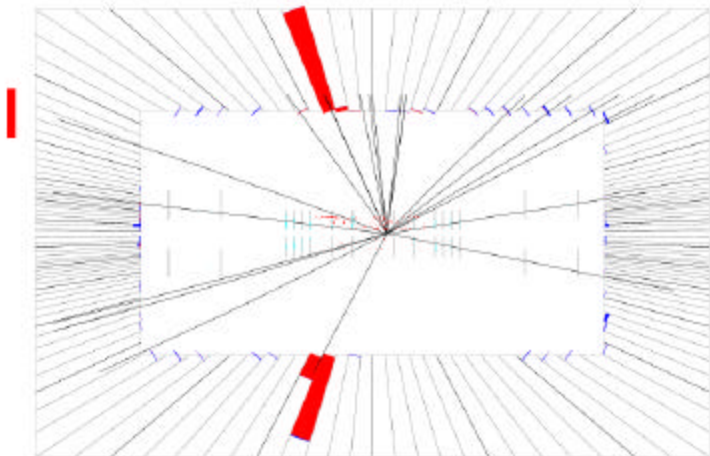
- Roughly 140-170 pb⁻¹
- Channels WZ → ll + n
- 1 event expected w/ 0.4 event background
- 1 event observed
- s = < 15.1 pb at 95% CL



Searches for NP: Extra Dimensions

Signal would be an excess of ee , mm , gg events at large mass and large angle, due to virtual graviton exchange

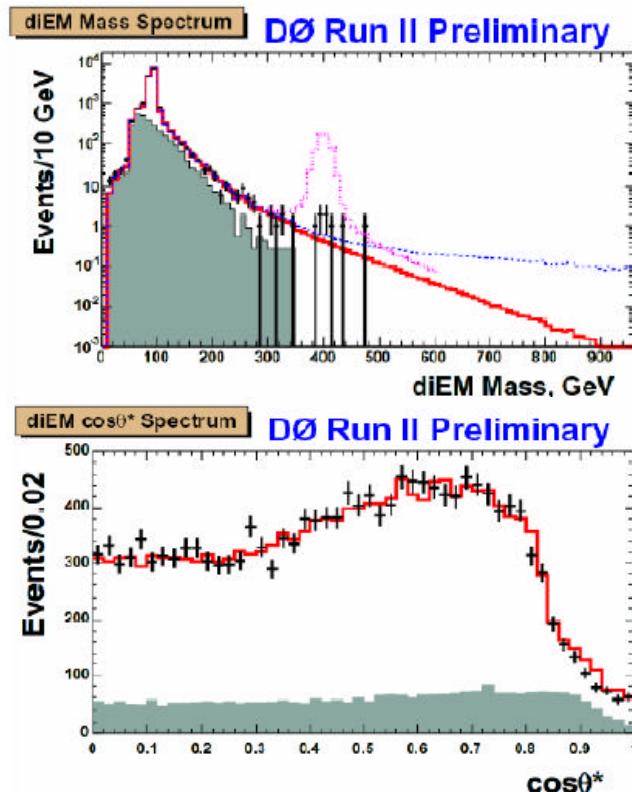
High-mass electron pair event
mass = 475 GeV, $\cos \theta^* = 0.01$



Latest DØ limits from $pp \rightarrow ee, mm, gg$

$M_S(\text{GRW}) > 1.43 \text{ TeV}$ ($\sim 200 \text{ pb}^{-1}$, 95% CL)

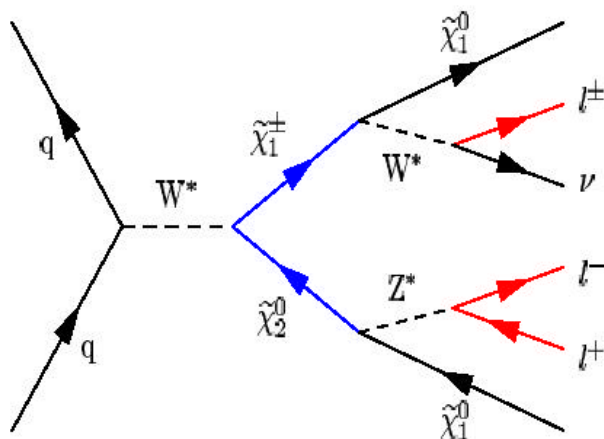
most stringent limit to date on large extra dimensions



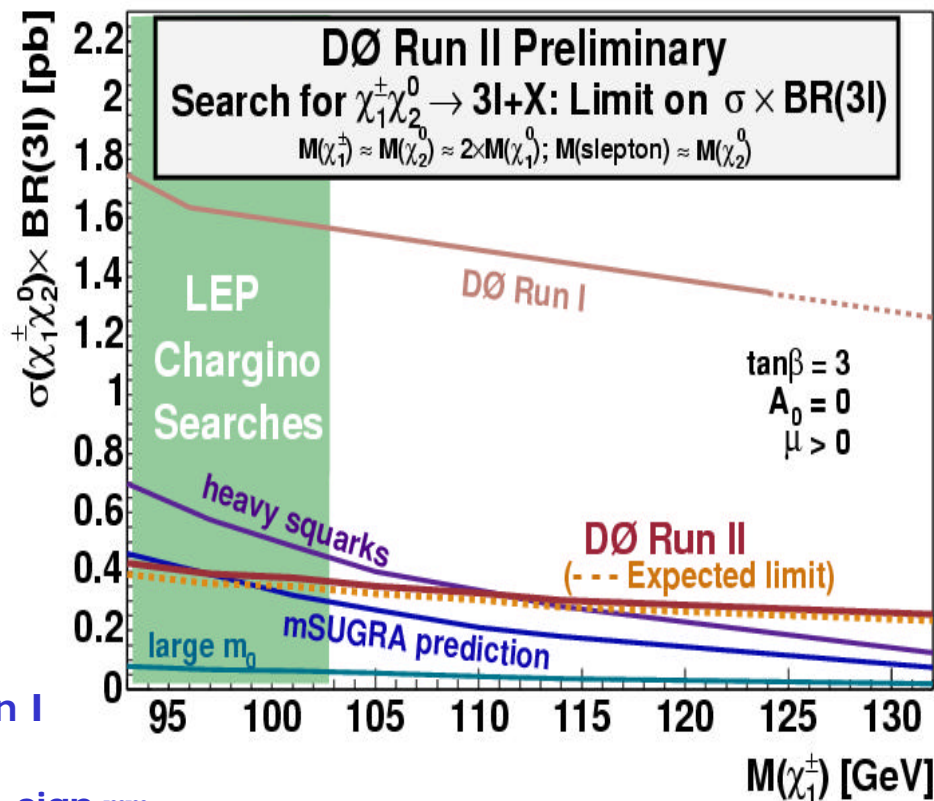
Same dataset places limits on TeV-scale extra dimensions, Z' ...

Golden Chargino & Neutralino Searches

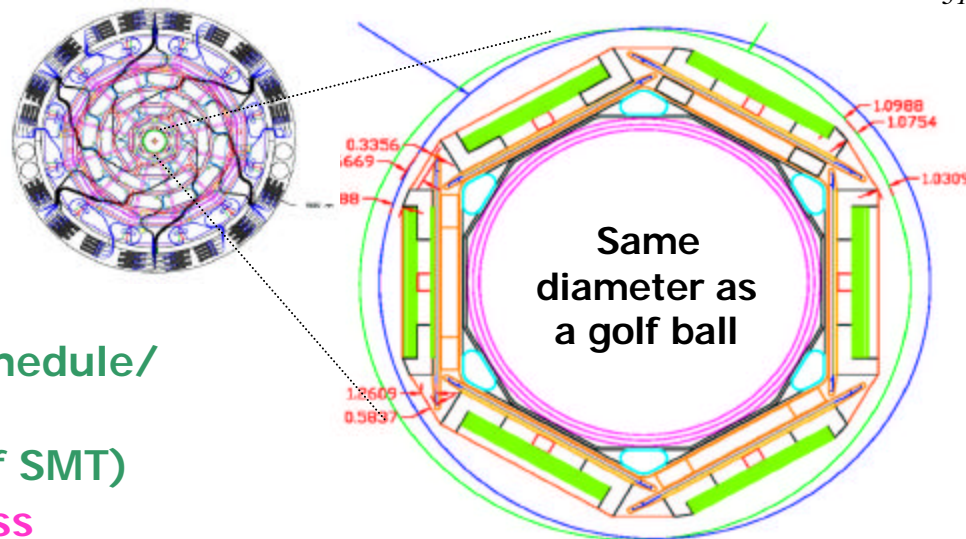
Chargino + neutralino
associated production
dilepton and trilepton
signatures



- Major improvement in sensitivity over Run I
- 150-250 pb^{-1}
- Three events observed in eel, mml, eml, like-sign mm
- Expected background of 2.9.



Upgrade News



- Status (See talk by V. O'Dell).
 - Trigger improvements on schedule/budget
 - Layer 0 (a new inner layer of SMT)
 - Making excellent progress
 - Currently surveying aperture (major shutdown activity #3)
- AFE II – t recently proposed
 - Improve CFT performance and provide timing information, should decrease occupancy and processing time.
 - Successfully negotiated engineering assistance from Fermilab
 - Collaboration review in December, sharpen physics case and review scheduling concerns.
 - Directorate review in January
- Standing Committee on Installation to Physics Commissioning
 - First draft August 15
 - Now incorporating comments from the project managers
 - First report to recently delivered to Spokespersons

Conclusions

- The DØ detector is working well at ~85% efficiency
- Processing keeping pace
- Full program in all aspects of the Standard Model and New Phenomena → now publishing at a healthy rate
- The collaboration is enthusiastic → 0.5 fb⁻¹ data to tape
- Preparing for the future.

Interesting events in a number of analyses at the limit of sensitivity ...stay tuned!



B_s Mixing Reach

